



ELECTRONICS

Product Information

Customer :

DATE : 23.Nov.2005

**SAMSUNG TFT-LCD**  
**MODEL : LTI460HS-L01**

Any Modification of Specification is not allowed without SEC's Permission.

NOTE :

<b>Customer's Approval</b>	
SIGNATURE	DATE

APPROVAED BY <i>Kyungheon Ko</i>	DATE 23.Nov.2005
PREPARED BY <b>Jeong-Geun Han</b>	DATE 23.Nov.2005

LCD Application Engineering 3, TCS Team

Samsung Electronics Co . , LTD.



## Contents

Revision History	(3)
General Description	(4)
General Information	(4)
1. Absolute Maximum Ratings	(5)
2. Application information for I.D. (Information Display)	(6)
3. Optical Characteristics	(7)
4. Electrical Characteristics	(10)
4.1 TFT LCD Module	
4.2 Back Light Unit	
4.3 Inverter Input & Specification	
5. Block Diagram	(13)
6. Input Terminal Pin Assignment	(14)
6.1 Input Signal & Power	
6.2 Inverter Input Pin Configuration	
6.3 Inverter Input Power Sequence	
6.4 LVDS Interface	
6.5 Input Signals, Basic Display Colors and Gray Scale of Each Color	
7. Interface Timing	(19)
7.1 Timing Parameters (DE only mode)	
7.2 Timing Diagrams of interface Signal (DE only mode)	
7.3 Power ON/OFF Sequence	
8. Outline Dimension	(22)
9. Packing	(24)
10. Marking & Others	(25)
11. Inspection Criteria	(26)
12. General Precaution	(27)
12.1 Handling	
12.2 Storage	
12.3 Operation	
12.4 Operation Condition Guide	
12.5 Others	

**\* Revision History**

Date	Rev. No	Page	Summary
Aug 04, 2005	000	all	First issued
Nov 23, 2005	001	7	C/R Min / Typ : 600 / 800 → 800 / 1200
			Rising Time Typ / Max : 3.5 / 10 → 8 / 10 Falling Time Typ / Max : 4.5 / 10 → 6 / 10
		12	Dimming Voltage [ 0V:Min, 3.3V:Max ] → [ 0V:Min, 2.5V:Max ]
		16	Pin 13 Dimming Control [ 0V:Min, 3.3V:Max ] → [ 0V:Min, 2.5V:Max ]
Inverter Input Power Sequence Diagram Changed			

## General Description

### Description

LTI460HS-L01 is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT (Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit. The resolution of a 46.0" is 1920 x 1080 and this model can display up to 16.7 million colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide an excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV, Display terminals for AV application products, and High Definition TV (HDTV).

### Features

- RoHS compliance (Pb-free)
- High contrast ratio, high aperture ratio, fast response time
- SPVA (Super Patterned Vertical Align) mode
- Wide viewing angle ( $\pm 178^\circ$ )
- High speed response
- Wide UXGA (1920 x 1080 pixels) resolution (16:9)
- Low Power consumption
- Direct Type 24 CCFTs (Cold Cathode Fluorescent Tube)
- DE (Data Enable) mode
- 2 ch LVDS (Low Voltage Differential Signaling) interface (2pixel/clock)

## General Information

Items	Specification	Unit	Note
Module Size	1083.0(H <sub>TYP</sub> ) x 627.0(V <sub>TYP</sub> )	mm	$\pm 1.0$ mm
	57.5(D <sub>MAX</sub> )		
Weight	18,000(Max.)	g	
Pixel Pitch	0.53025(H) x 0.17675(W)*3	mm	
Active Display Area	1018.08(H) x 572.67(V)	mm	
Surface Treatment	Haze 44% , Hard-coating (3H)		
Display Colors	8 bit - 16.7M	colors	
Number of Pixels	1920 x 1080	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally Black		
Luminance of White	450 (Typ.)	cd/m <sup>2</sup>	

## 1. Absolute Maximum Ratings

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	$V_{DD}$	GND-0.5	6.5	V	(1)
Storage temperature	$T_{STG}$	-20	60		(2)
Glass surface temperature (Operation)	Center	$T_{OPR}$	0	50	(2),(5)
	T.Uniformity	T	-	10	
Shock ( non - operating )	$S_{nop}$	-	50	G	(3)
Vibration ( non - operating )	$V_{nop}$	-	1.5	G	(4)

Note (1)  $T_a = 25 \pm 2 \text{ }^\circ\text{C}$

(2) Temperature and relative humidity range are shown in the figure below.

a. 90 % RH Max. ( $T_a = 39 \text{ }^\circ\text{C}$ )

b. Maximum wet-bulb temperature at  $39 \text{ }^\circ\text{C}$  or less. ( $T_a = 39 \text{ }^\circ\text{C}$ )

c. No condensation

(3) 11ms, sine wave, one time for  $\pm X$ ,  $\pm Y$ ,  $\pm Z$  axis

(4) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

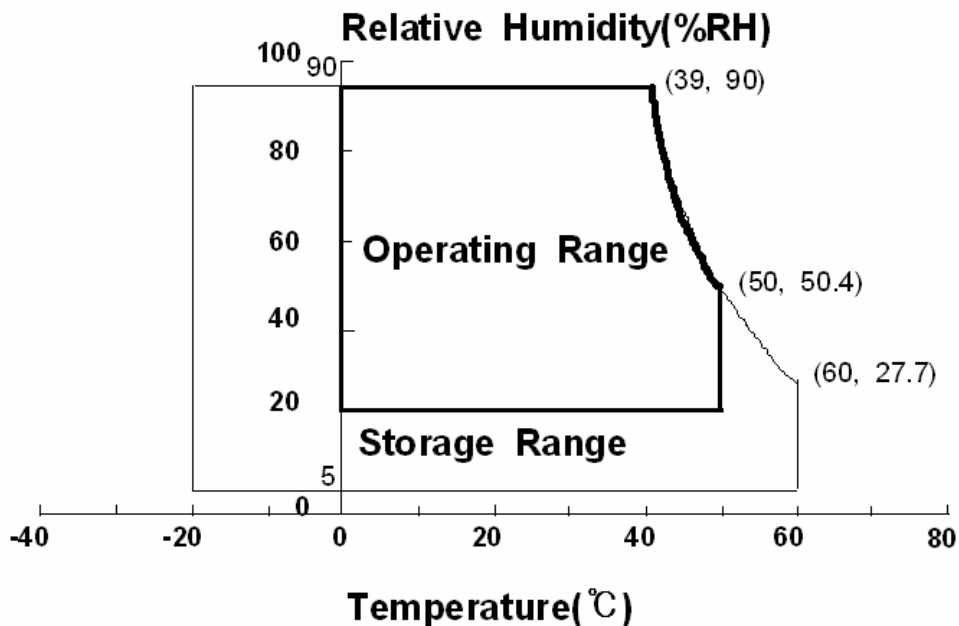
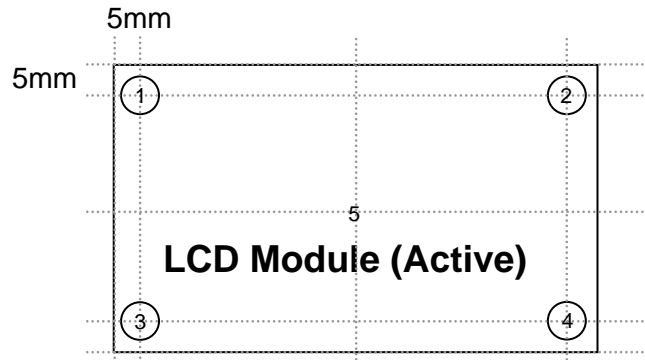


Fig. Temperature and Relative humidity range

(5) Definition of test point



T should be less than 10 (  $T = |T_{\text{OPR}} - T_{\text{MAX}}|$  )

$T_{\text{OPR}}$  : Temperature of the center of the glass surface (Test point 5)

$T_1 \sim T_4$  : Temperature of each edge of the glass surface

$T_{\text{MAX}}$  : The highest temperature of the glass surface

## 2. Application information for I.D. (Information Display)

- Generally large-sized LCD modules are designed for TV applications. Accordingly, a long-term display like in PID application, can cause uneven display including image retention. To optimize module's lifetime and function, several operating usages are required.

### 1. Normal operating condition

- Temperature:  $20 \pm 15$
- Humidity:  $65 \pm 20$  %
- Display pattern: dynamic pattern

Note) Long-term static display can cause image retention.

### 2. Operating usages under abnormal condition1)

- Ambient condition
  - Well-ventilated place is recommended to set up ID system.
- Power and screen save
  - Periodical power-off or screen save2) is needed after long-term display.

### 3. Operating usages to protect against image retention due to long-term static display

- Suitable operating time: under 18 hours a day.
- Static information display recommended to use with moving image.
  - Cycling display between 5 minutes' information display and 10 seconds' moving image.
- Background and character (image) color change
  - Use different colors for background and character, respectively.
  - Change colors themselves periodically.
- Avoid combination of background and character with large different luminance.

1) Abnormal condition just means conditions except normal condition.

2) Black image or moving image is strongly recommended as a screen save.

4. Lifetime in this spec. is guaranteed only when ID is used according to operating usages.

### 3. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.

Measuring equipment : TOPCON BM-7,SPECTRORADIOMETER SR-3

( $T_a = 25 \pm 2^\circ\text{C}$ ,  $V_{DD}=5\text{V}$ ,  $f_v= 60\text{Hz}$ ,  $f_{DCLK}=74.25\text{MHz}$ ,  $I_L = 6.0\text{mA}$ )

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Contrast Ratio (Center of screen)	C/R	Normal $\theta_{L,R}=0$ $\theta_{U,D}=0$  Viewing Angle	800	1200	-		(3) SR-3	
Response Time	Rising		Tr	-	8	10	Msec	(5) BM-7
	Falling		Tf	-	6	10		
	G-to-G		Tg	-	8	-		
Luminance of White (Center of screen)	$Y_L$			400	450	-	cd/m <sup>2</sup>	(6) SR-3
Color Chromaticity (CIE 1931)	Red		Rx	TYP. -0.03	0.648	TYP. +0.03		(7),(8) SR-3
			Ry		0.333			
	Green		Gx		0.271			
			Gy		0.592			
	Blue		Bx		0.141			
		By	0.066					
	White	Wx	0.280					
		Wy	0.290					
Color Gamut	-		-	72	-	%	(7) SR-3	
Color Temperature	T		-	10000	-	K	(7) SR-3	
Viewing Angle	Hor.	$\theta_L$	C/R 10	75	89	-	Degree	(8) SR-3
		$\theta_R$		75	89	-		
	Ver.	$\theta_U$		75	89	-		
		$\theta_D$		75	89	-		
Brightness Uniformity (9 Points)	$B_{uni}$		-	-	25	%	(4) SR-3	

#### Note (1) Test Equipment Setup

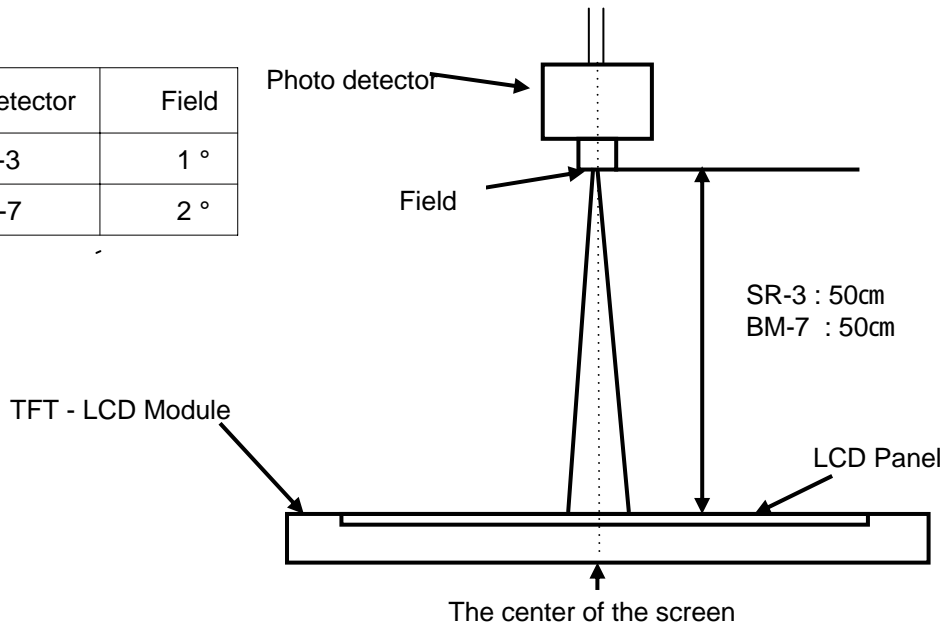
The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

Single lamp current : 6.0mA

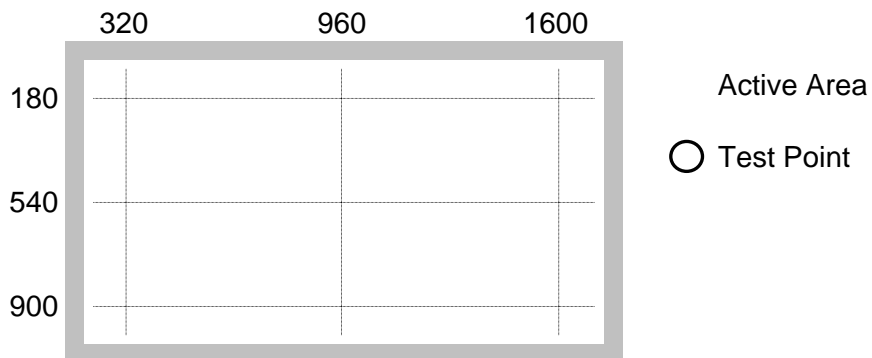
Environment condition :  $T_a = 25 \pm 2^\circ\text{C}$

MODEL	LTI460HS-L01	Doc. No	05-001-G-051123	Page	7 / 29
-------	--------------	---------	-----------------	------	--------

Photo detector	Field
SR-3	1 °
BM-7	2 °



Note (2) Definition of test point



Note (3) Definition of Contrast Ratio (C/R)

: Ratio of gray max (Gmax) & gray min (Gmin) at the center point of the panel

$$C/R = \frac{G_{\max}}{G_{\min}}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

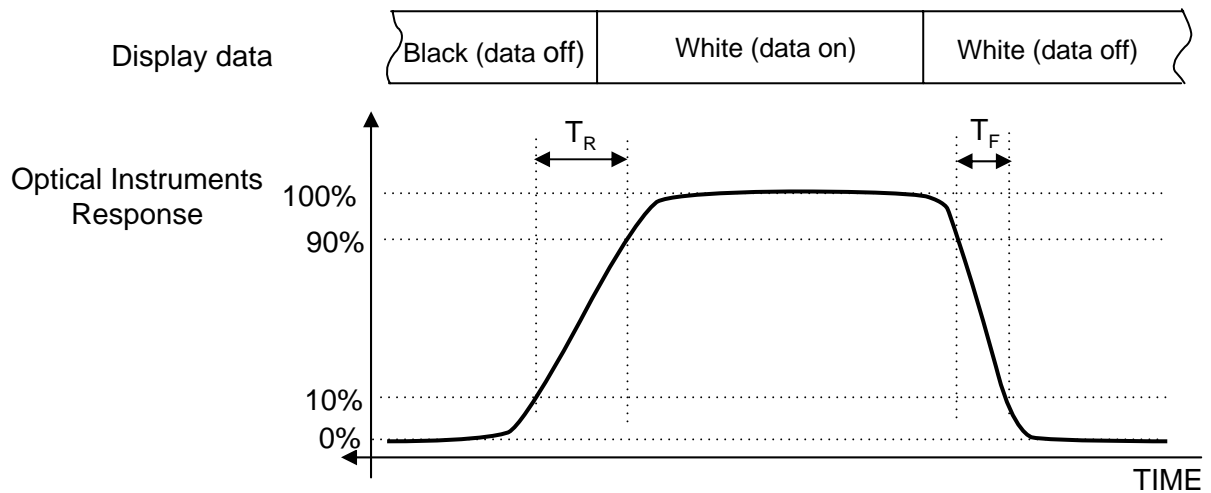
Note (4) Definition of 9 points brightness uniformity

$$B_{uni} = 100 * \frac{(B_{max} - B_{min})}{B_{max}}$$

Bmax : Maximum brightness

Bmin : Minimum brightness

Note (5) Definition of Response time : Sum of Tr, Tf



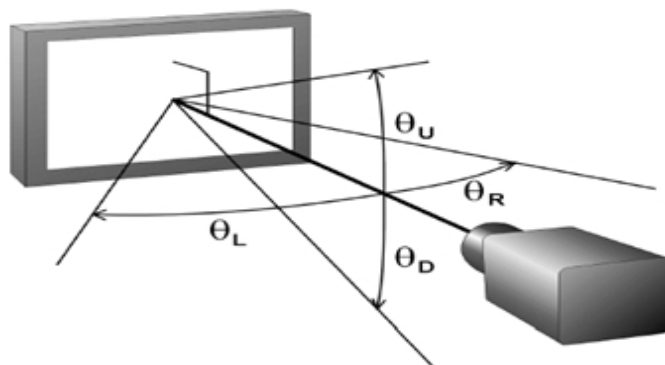
Note (6) Definition of Luminance of White : Luminance of white at center point

Note (7) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red, Green, Blue & White at center point

Note (8) Definition of Viewing Angle

: Viewing angle range (C/R 10)



## 4. Electrical Characteristics

### 4.1 TFT LCD Module

The connector for display data & timing signal should be connected.

$T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply	$V_{DD}$	4.5	5.0	5.5	V	(1)
Current of Power Supply	(a) Black	-	2300	-	mA	(2),(3)
	(b) White	-	2750	-	mA	
	(c) N-Pattern	-	3600	4500	mA	
Vsync Frequency	$f_V$	-	60	-	Hz	
Hsync Frequency	$f_H$	65.5	67.5	-	kHz	
Main Frequency	$f_{DCLK}$	65.5	74.25	83.4	MHz	
Rush Current	$I_{RUSH}$	-	-	12	A	(4)

Note (1) The ripple voltage should be controlled under 10% of  $V_{DD}$ .

(2)  $f_V=60\text{Hz}$ ,  $f_{DCLK} = 74.25\text{MHz}$ ,  $V_{DD} = 5.0\text{V}$ , DC Current.

(3) Power dissipation check pattern (LCD Module only)

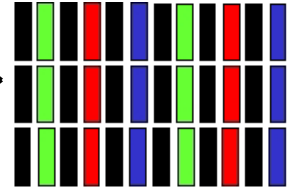
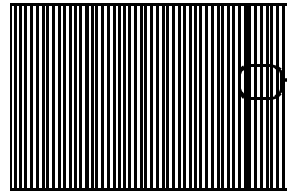
a) Black Pattern



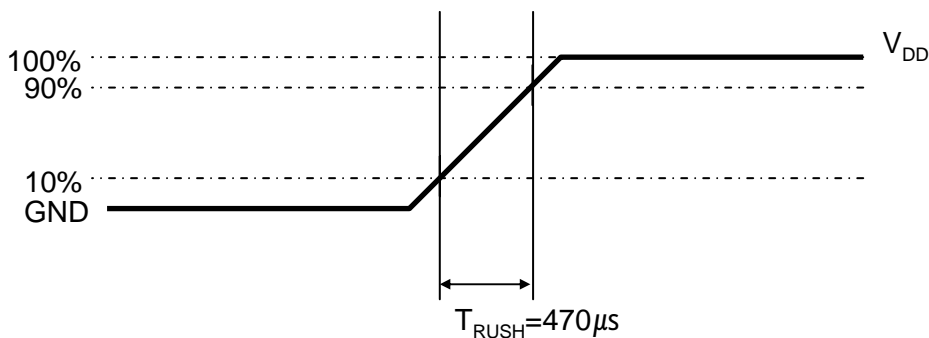
b) White Pattern



c) N-Pattern



(4) Measurement Conditions



Rush Current  $I_{RUSH}$  can be measured when  $T_{RUSH}$  is  $470\mu s$ .

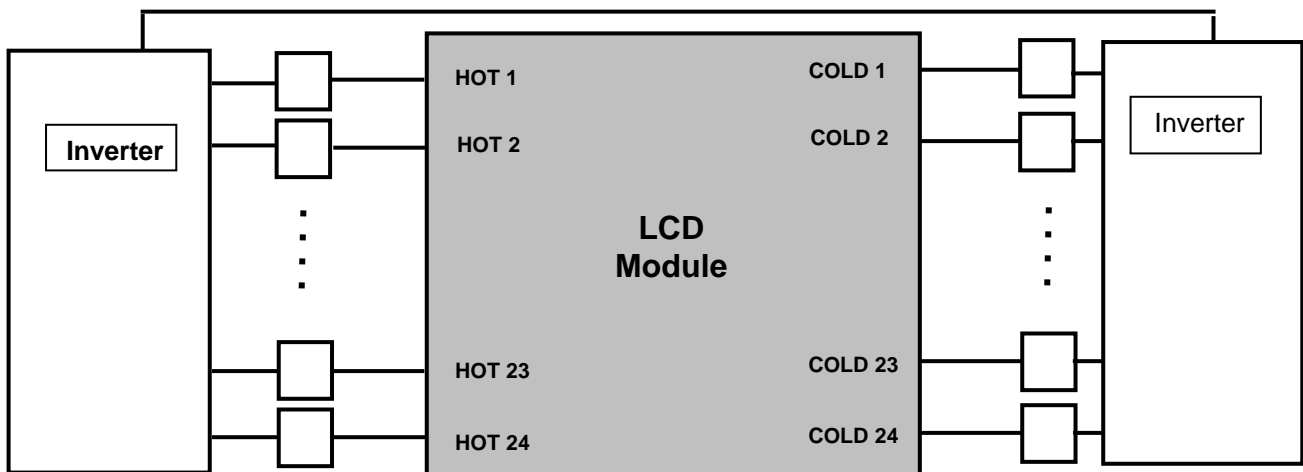
## 4.2 Back Light Unit

The back light unit contains 24 *direct-lighting type CCFTs* ( Cold Cathode Fluorescent Tube ). The characteristics of lamps are shown in the following tables.

Ta=25 ± 2°C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Lamp Current	$I_L$	4.0	6.0	7.0	mArms	
Lamp Voltage	$V_L$	-	1780	-	Vrms	
Operating Life Time	Hr	50,000	-	-	Hour	(1)
Startup Voltage	$V_s$	-	-	0 : (2830)	Vrms	
				25 : (2175)		

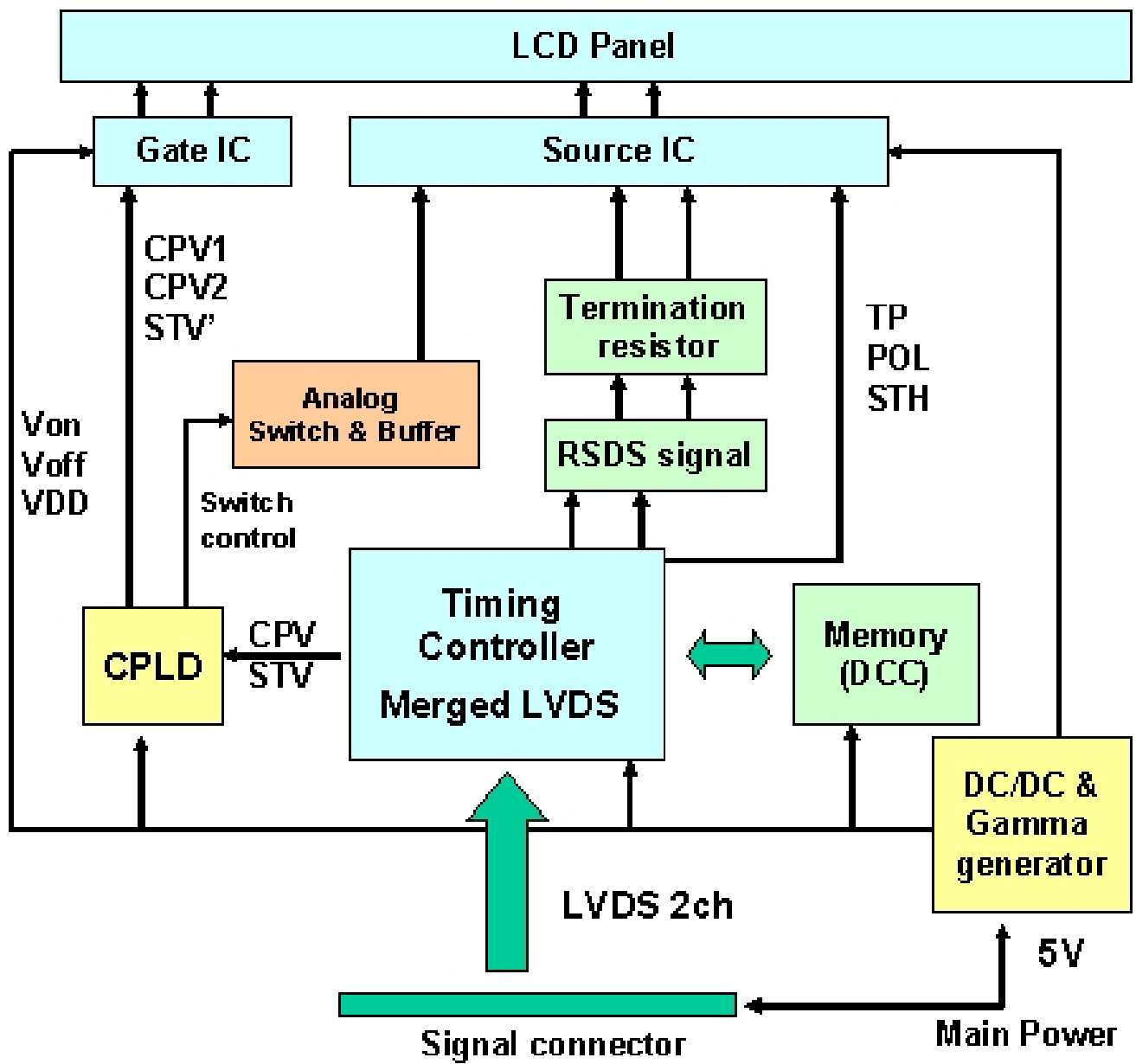
Note (1) Life time (Hr) of a lamp : It is defined as the time in which it continues to operate under the condition of  $T_a = 25 \pm 2$  and  $I_L = 6.0\text{mArms}(\text{typ.})$  for a lamp until the brightness becomes 50% or lower than it's original value.



### 4.3 Inverter Input Condition & Specification

Items	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Input Voltage	V <sub>in</sub>	-	21.6	24	26.4	V	T <sub>a</sub> =25±2 °C
Input Current	I <sub>RUSH</sub>	V <sub>in</sub> =24.0V V <sub>dim</sub> =3.3V	-	-	10.01	A	Initial Turn-on
Lamp Current	I <sub>O</sub>	V <sub>dim</sub> =3.3 V	5.5	6.0	6.5	mArms	-
Frequency	F <sub>LAMP</sub>	V <sub>in</sub> =24.0 V	55	60	65	kHz	-
Backlight On/Off	ON	V <sub>in</sub> =24.0 V	2.4	-	5.25	V	-
	OFF	V <sub>in</sub> =24.0 V	0	-	0.8		
Dimming Control	V <sub>DIM</sub>	Max Lum	2.5	-	-	V	-
		Min. Lum	-	-	0		

## 5. Block Diagram



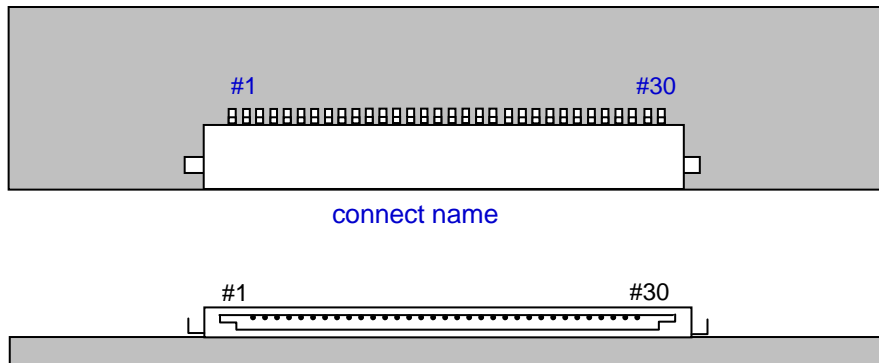
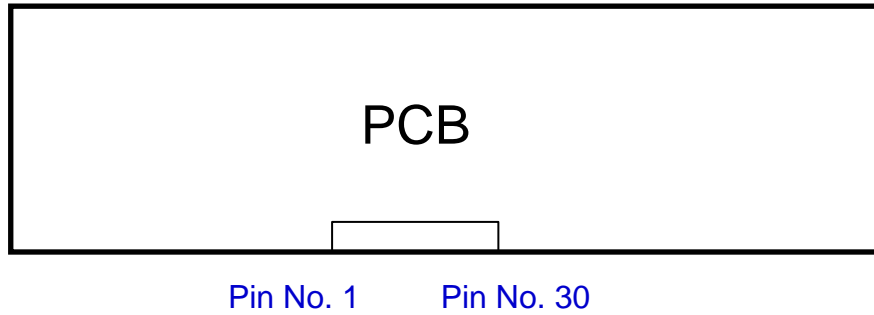
## 6. Input Terminal Pin Assignment

### 6.1. Input Signal & Power

Connector : FI-E30S (JAE)

No	Signal	No	Signal
1	RxInO0-	16	RxInE2+
2	RxInO0+	17	RxInECLK-
3	RxInO1-	18	RxInECLK+
4	RxInO1+	19	RxInE3-
5	RxInO2-	20	RxInE3+
6	RxInO2+	21	GND
7	RxInOCLK-	22	GND
8	RxInOCLK+	23	GND
9	RxInO3-	24	GND
10	RxInO3+	25	GND
11	RxInE0-	26	V <sub>DD</sub> (= +5[V])
12	RxInE0+	27	V <sub>DD</sub> (= +5[V])
13	RxInE1-	28	V <sub>DD</sub> (= +5[V])
14	RxInE1+	29	V <sub>DD</sub> (= +5[V])
15	RxInE2-	30	V <sub>DD</sub> (= +5[V])

Note(2) Pin number starts from Right side



**Fig. Connector diagram**

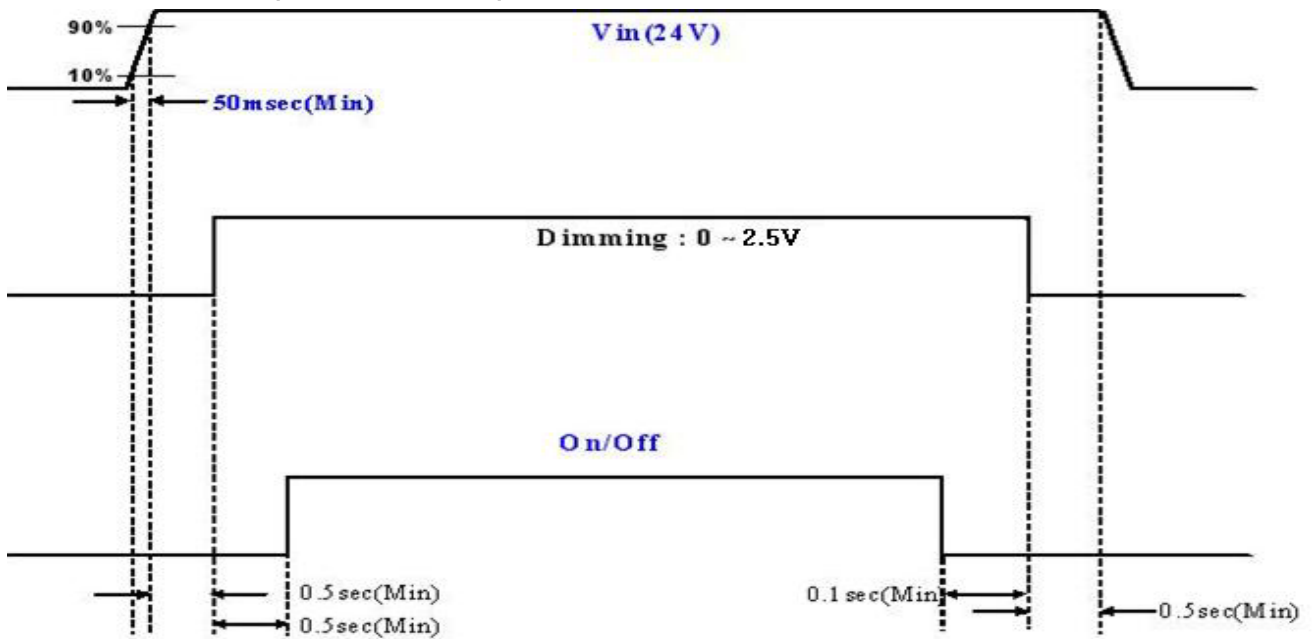
- a. All GND pins should be connected together and also be connected to the LCD's metal chassis.
- b. All power input pins should be connected together.
- c. All NC pins should be separated from other signal or power.

## 6.2. Inverter Input Pin Configuration

Connector : S14B-PHA-SM-TB(JST)

Pin No.	Pin Configuration(FUNCTION)
1	24 V
2	24 V
3	24 V
4	24 V
5	24 V
6	GND
7	GND
8	GND
9	GND
10	GND
11	No Connection * ERROR DETECTION (NORMAL : GND / ABNORMAL : 5V)
12	Backlight On /Off [ON: 2.4 - 5.25 V, OFF: 0 - 0.8 V]
13	Dimming Control [0V:Min, 2.5V:Max]
14	No Connection

## 6.3. Inverter Input Power Sequence



## 6.4 LVDS Interface

- LVDS Receiver : Tcon (merged)
- Data Format (JEIDA & Normal)

LVDS Transmitter ( ex : <i>DS90C385</i> ) Signal Interface					
Device Input Pin	Device Input Signal		Output Signal	To LTA460H2 Interface	
Symbol	Symbol	Function		Terminal	Symbol
TXIN0	R0	Red Pixel Data (LSB)	TXOUT0- TXOUT0+	No. 1,11 No. 2,12	RX0- RX0+
TXIN1	R1	Red Pixel Data			
TXIN2	R2	Red Pixel Data			
TXIN3	R3	Red Pixel Data			
TXIN4	R4	Red Pixel Data			
TXIN5	R7	Red Pixel Data (MSB)	TXOUT3- TXOUT3+	No. 9,19 No. 10,20	RX3- RX3+
TXIN6	R5	Red Pixel Data	TXOUT0- TXOUT0+	No. 1,11 No. 2,12	RX0- RX0+
TXIN7	G0	Green Pixel Data (LSB)			
TXIN8	G1	Green Pixel Data	TXOUT1- TXOUT1+	No. 3, 13 No. 4, 14	RX1- RX1+
TXIN9	G2	Green Pixel Data			
TXIN10	G6	Green Pixel Data			
TXIN11	G7	Green Pixel Data (MSB)	TXOUT3- TXOUT3+	No. 9,19 No. 10,20	RX3- RX3+
TXIN12	G3	Green Pixel Data	TXOUT1- TXOUT1+	No. 3, 13 No. 4, 14	RX1- RX1+
TXIN13	G4	Green Pixel Data			
TXIN14	G5	Green Pixel Data			
TXIN15	B0	Blue Pixel Data (LSB)			
TXIN16	B6	Blue Pixel Data	TXOUT3- TXOUT3+	No. 9,19 No. 10,20	RX3- RX3+
TXIN17	B7	Blue Pixel Data (MSB)			
TXIN18	B1	Blue Pixel Data	TXOUT1- TXOUT1+	No. 3, 13 No. 4, 14	RX1- RX1+
TXIN19	B2	Blue Pixel Data	TXOUT2- TXOUT2+	No. 5, 15 No. 6, 16	RX2- RX2+
TXIN20	B3	Blue Pixel Data			
TXIN21	B4	Blue Pixel Data			
TXIN22	B5	Blue Pixel Data			
TXIN24	Hsync	Horizontal Sync (Don't care)			
TXIN25	Vsync	Vertical Sync (Don't care)			
TXIN26	DE	Data Enable (Mandatory)			
TXIN27	R6	Red Pixel Data	TXOUT3- TXOUT3+	No. 9,19 No. 10,20	RX3- RX3+

## 6.5 Input Signals, Basic Display Colors and Gray Scale of Each Color

COLOR	DISPLAY (8bit)	DATA SIGNAL																								GRAY SCALE LEVEL
		RED							GREEN							BLUE										
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0	
	DARK	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1	
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~ R252	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	LIGHT	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R252	
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R252	
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R252	
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0	
	DARK	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1	
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	G2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~ G252	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	LIGHT	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	G252	
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	G252	
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	G252	
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0	
	DARK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B1	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	B2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~ B252	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	B252	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	B252	
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B252	

Note) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

## 7. Interface Timing

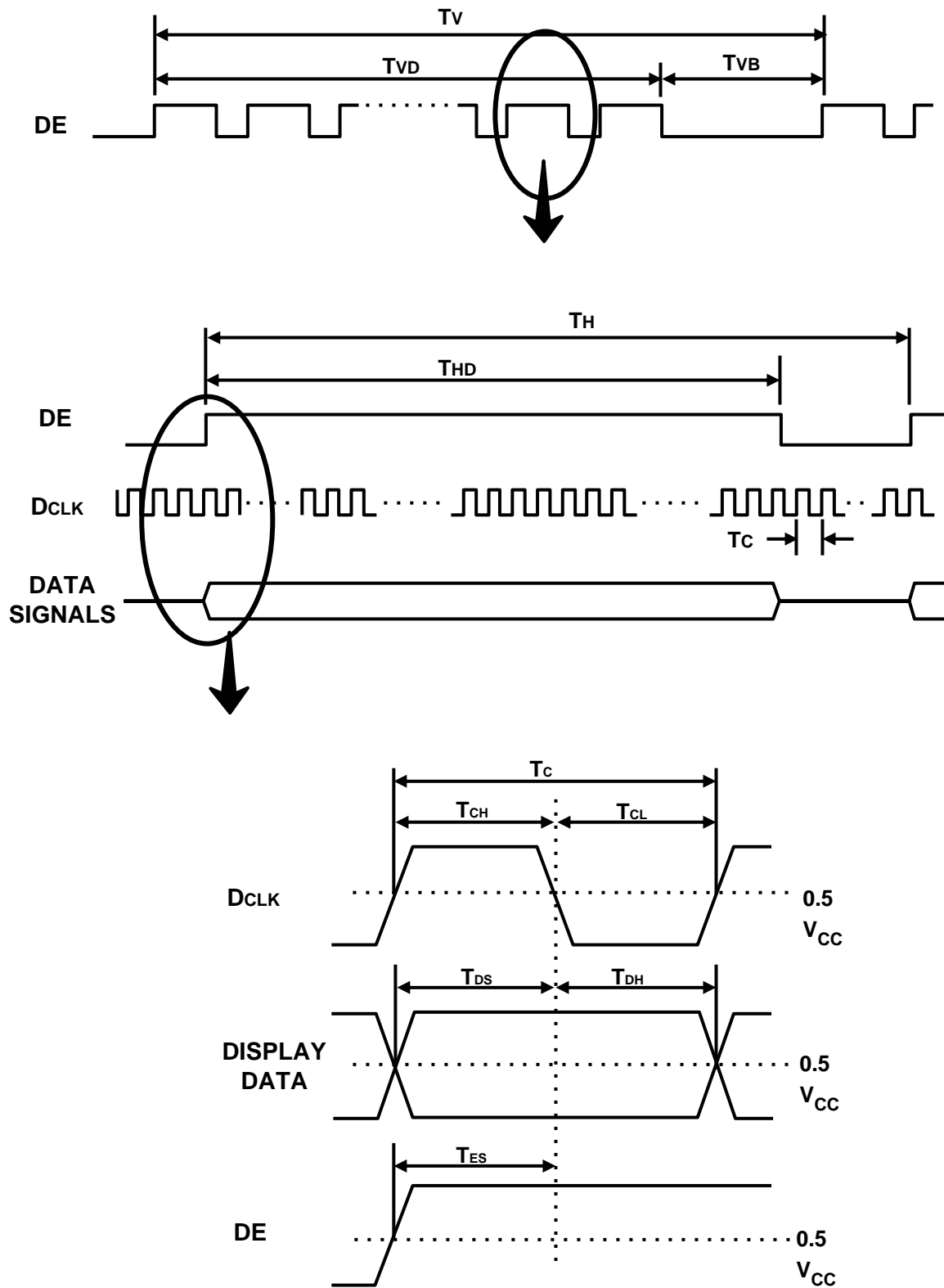
### 7.1 Timing Parameters ( DE only mode )

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	65.5	74.25	83.4	MHz	-
Hsync		$F_H$	65.5	67.5	69.5	KHz	-
Vsync		$F_V$		60		Hz	-
Vertical Display Term	Active Display Period	$T_{VD}$	-	1080	-	Line	-
	Vertical Total	$T_V$	1092	1125	1158	Line	-
Horizontal Display Term	Active Display Period	$T_{HD}$	-	1920	-	Clock	-
	Horizontal Total	$T_H$	2000	2200	2400	Clock	-

Note) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.

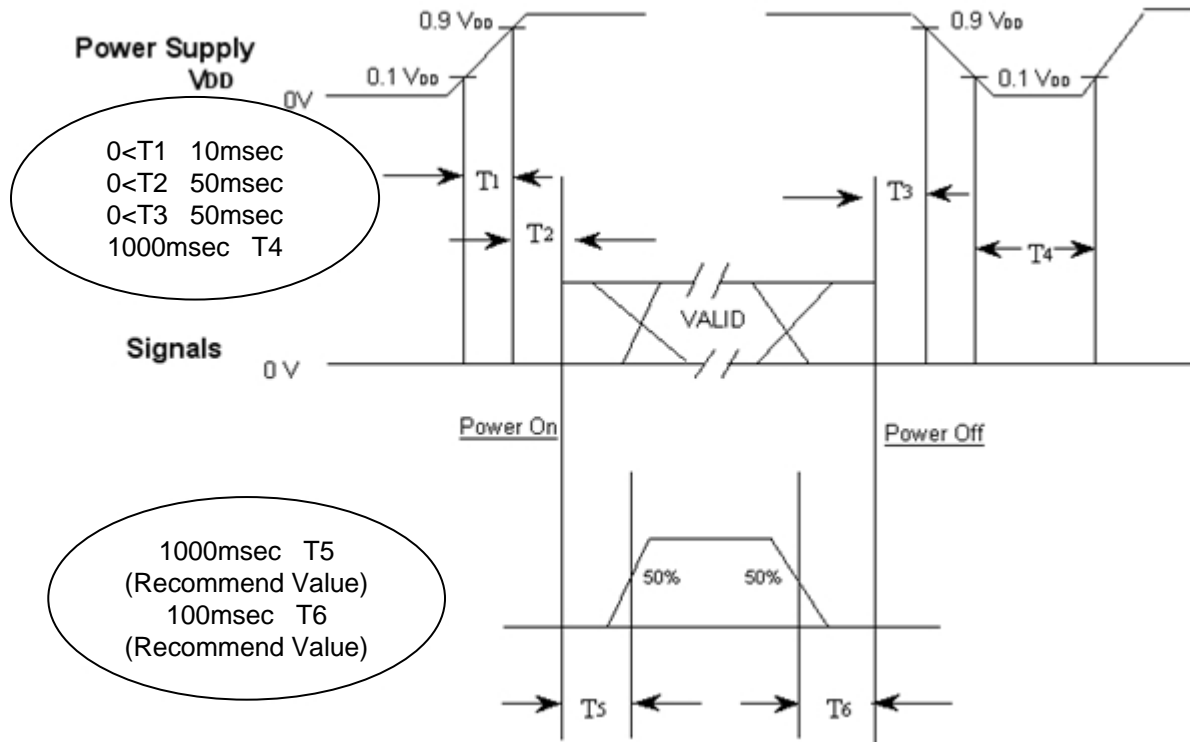
- (1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system
- (2) Internal  $V_{DD} = 3.3V$

## 7.2 Timing diagrams of interface signal ( DE only mode )



### 7.3 Power ON/OFF Sequence

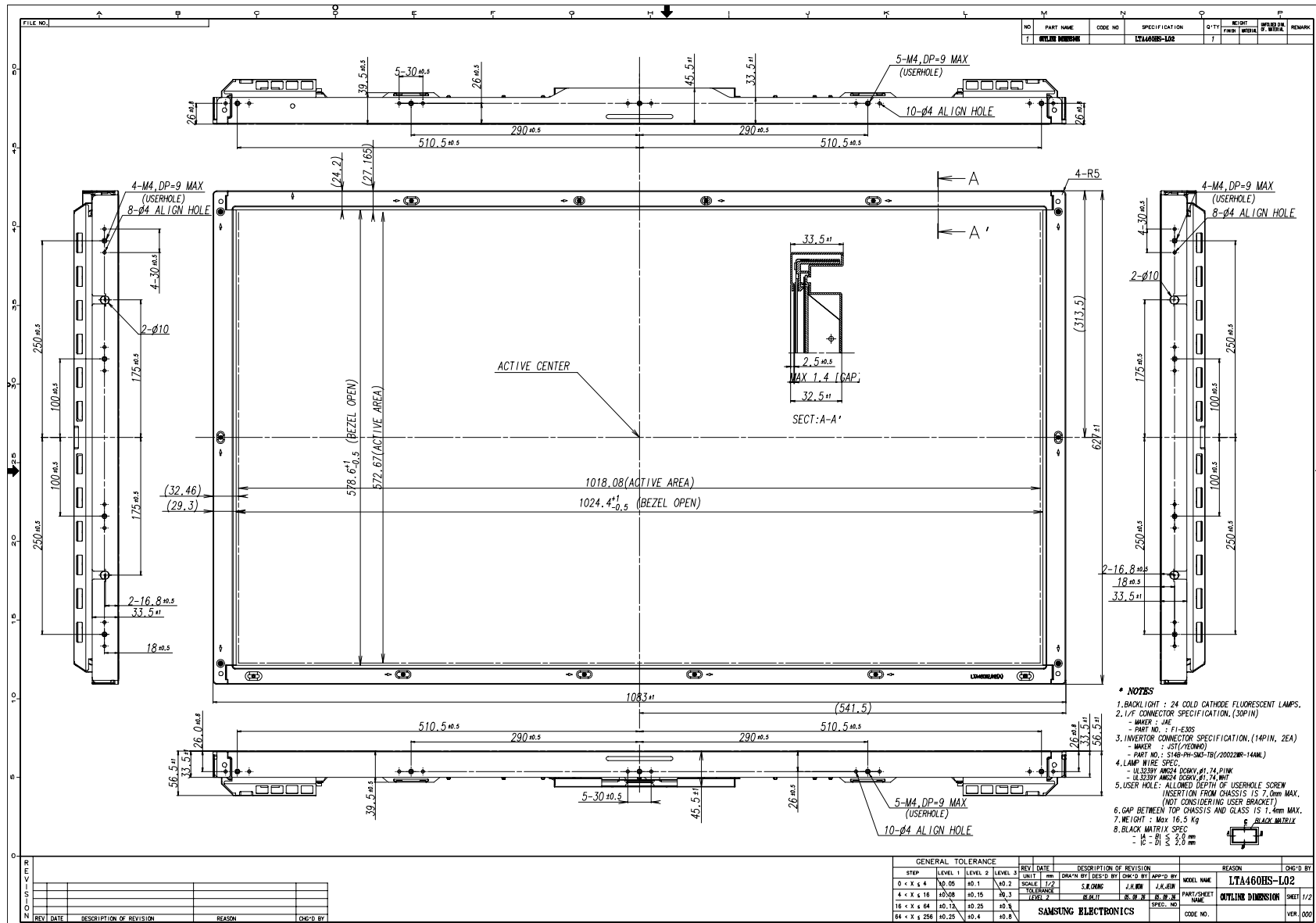
To prevent a latch-up or DC operation of the LCD Module, the power on/off sequence should be as the diagram below.



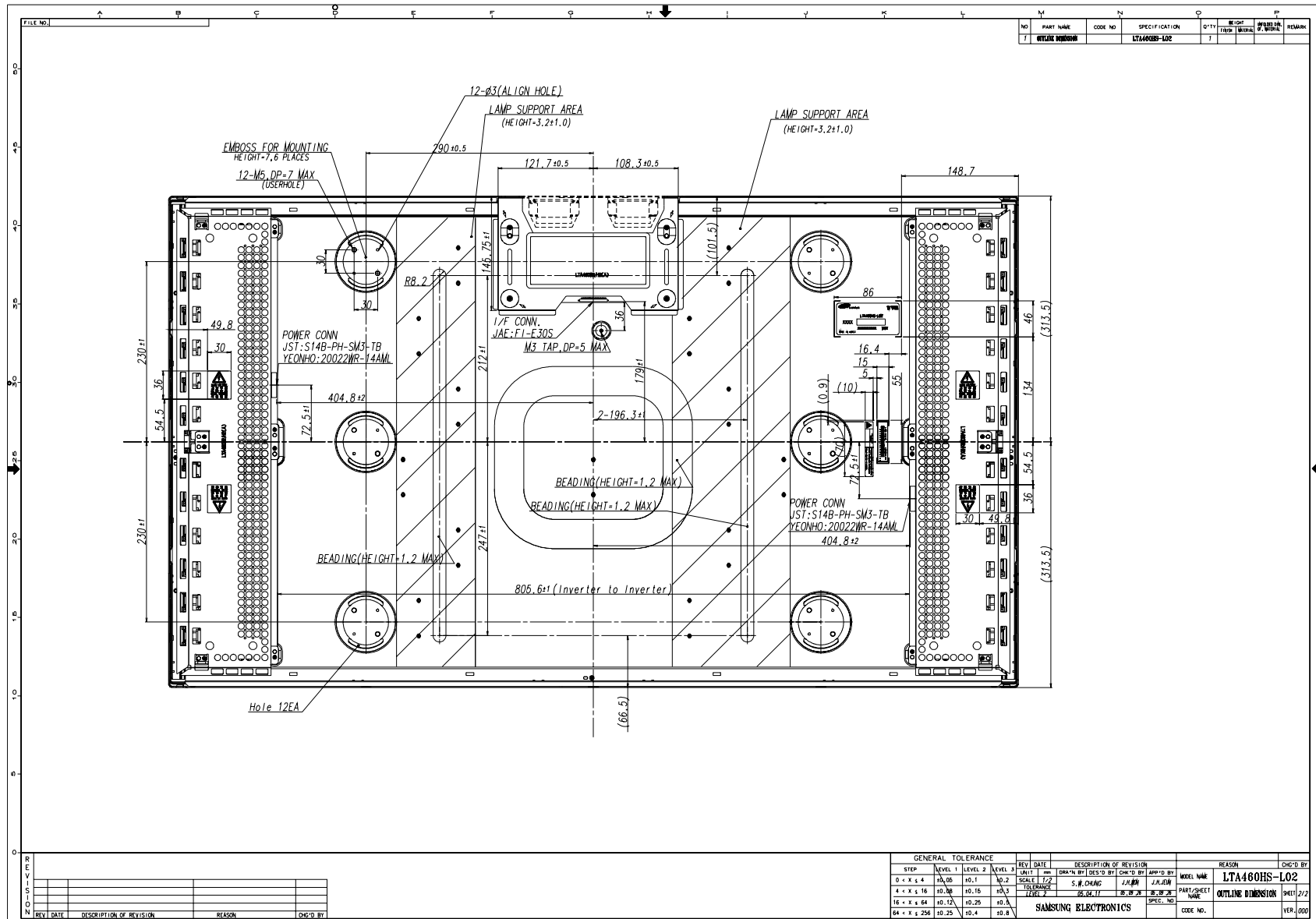
- T1 :  $V_{DD}$  rising time from 10% to 90%
- T2 : The time from  $V_{DD}$  to valid data at power ON.
- T3 : The time from valid data off to  $V_{DD}$  off at power Off.
- T4 :  $V_{DD}$  off time for Windows restart
- T5 : The time from valid data to B/L enable at power ON.
- T6 : The time from valid data off to B/L disable at power Off.

- The supply voltage of the external system for the Module input should be the same as the definition of  $V_{DD}$ .
- Apply the lamp voltage within the LCD operation range. When the back light turns on before the LCD operation or the LCD turns off before the back light turns off, the display may momentarily show abnormal screen.
- In case of  $V_{DD}$  = off level, please keep the level of input signals low or keep a high impedance.
- T4 should be measured after the Module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.

# 8. Outline Dimension (Front View)



# 8. Outline Dimension (Rear View)



## 9. PACKING

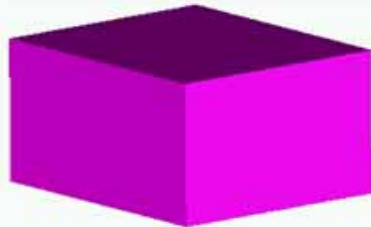
### 9.1 CARTON (Internal Package)

(1) Packing Form

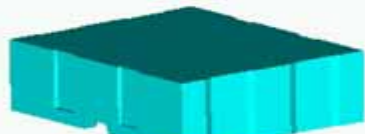
Corrugated fiberboard box and corrugated cardboard as shock absorber

(2) Packing Method

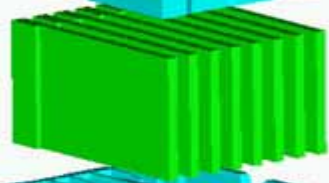
Packing -PalletBox



Cushion-pallet



LCD Module  
+Shielding Bag



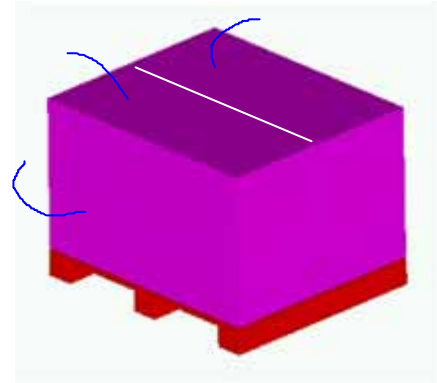
Cushion-pallet



Pallet



Direction: be able to open it



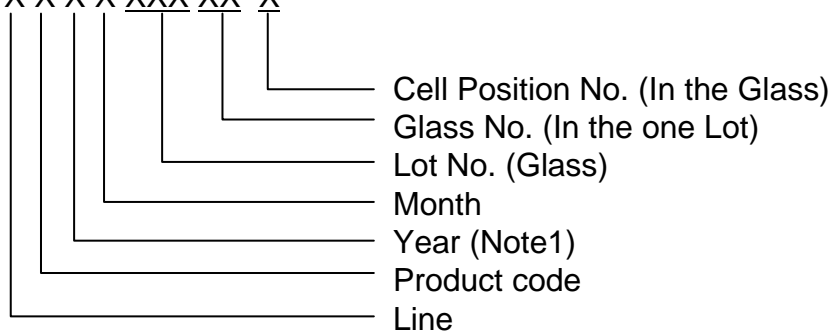
### 9.2 Packing Specification

Item	Specification	Remark
LCD Packing	10ea / (Packing-Pallet Box)	1. 170 Kg / LCD (10ea) 2. 10 Kg / Cushion-pallet (2ea) 3. 8 Kg / Packing-Pallet Box (1ea) >. Cushion-pallet Material : EPS >. Packing-Pallet Box Material : DW4
Pallet	1Box / Pallet	1. Pallet weight = 8.8kg
Packing Direction	Vertical	
Total Pallet Size	H x V x height	1270mm(H) x 1150mm(V) x 844mm(height)
Total Pallet Weight	197kg	Pallet(8.8kg) + Module(17*10=170) + Cushion(up+bottom=10kg) + Pallet-BOX(8kg)

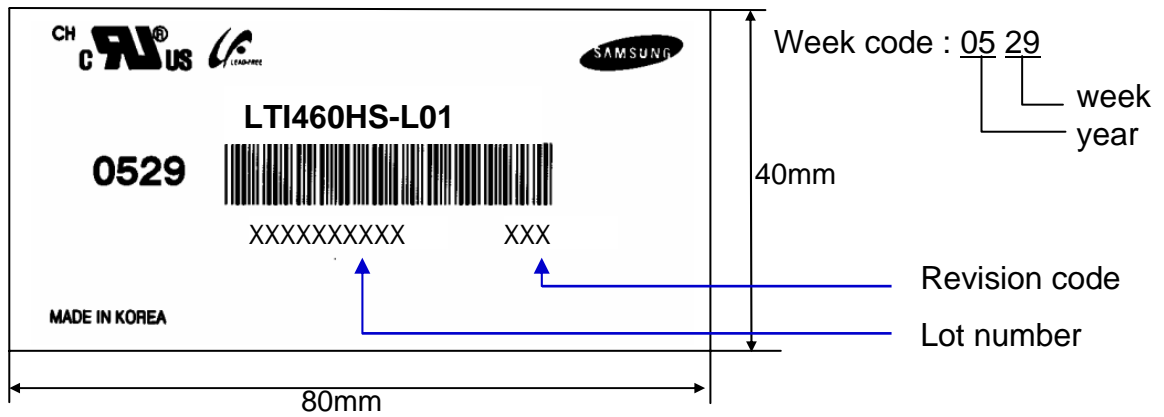
## 10. MARKING & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

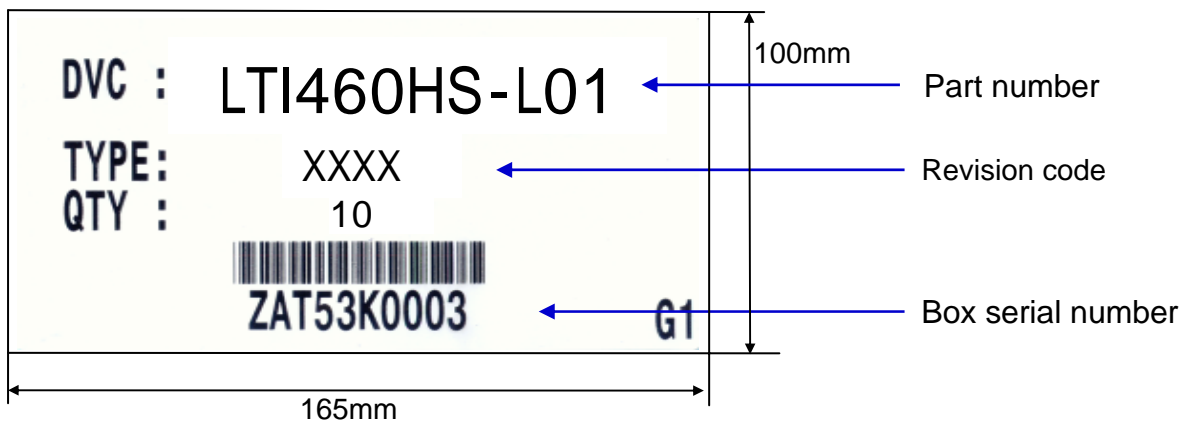
- (1) Parts number : LTI460HS-L01-XXXX
- (2) Revision: One letters
- (3) Lot number : X X X X XXX XX X



### (4) Nameplate Indication



### (5) Packing box attach



### (6) Others

- 1. After service part

Lamps cannot be replaced because of the narrow bezel structure.

MODEL	LTI460HS-L01	Doc. No	05-001-G-051123	Page	25 / 29
-------	--------------	---------	-----------------	------	---------

## 11. Inspection Criteria

When products are shipped, incoming inspection should be carried out with a sampling inspection based on MIL-STD-105E level II by AQL 1.0%.

### CHANGE CONTROL

Design of the product may be changed regarding the specifications, appearance, parts used, circuits, etc. for product improvement. If a design change is judged to affect the specifications of this product, supplier should inform customer of the change in advance.

### QUALITY CONTROL

In the event of a product failure under normal operating conditions, a product trouble or a functional disorder that can be deemed to be the responsibility of supplier, supplier should repair the fault or replace the product free of charge within one year from the product delivery date. However, supplier does not take responsibility for the product quality in the case of modifications not specified by supplier.

### MAINTENANCE

The specifications of the functions of maintenance parts may be partially changed within the range which provides equivalent or better quality. In principle, maintenance parts should be product units. When stopping manufacturing this product, supplier should notify customer in advance.

### HANDLING OF DOUBTFUL POINTS

Any doubt not stipulated in this specification is to be resolved by mutual agreement between customer and supplier, and supplier should make efforts for improvement in good faith.

MODEL	LT1460HS-L01	Doc. No	05-001-G-051123	Page	26 / 29
-------	--------------	---------	-----------------	------	---------

## 12. General Precautions

### 12.1 Handling

- (a) When the Module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist and bend the Module.
- (b) Because the inverter use high voltage, it should be disconnected from power before it is assembled or disassembled.
- (c) Refrain from strong mechanical shock and / or any force to the Module.  
In addition to damage, this may cause improper operation or damage to the Module and CCFT back light.
- (d) Note that polarizers are very fragile and could be damage easily.  
Do not press or scratch the surface harder than a HB pencil lead.
- (e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.
- (f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.
- (g) Desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane.  
Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away with soap thoroughly.
- (i) Protect the Module from static, or the CMOS Gate Array IC would be damaged.
- (j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (k) Do not disassemble the Module.
- (l) Do not pull or fold the lamp wire.
- (m) Do not adjust the variable resistor located on the Module.
- (n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (o) Pins of I/F connector should not be touched directly with bare hands.

## 12.2 Storage

- (a) Do not leave the Module in high temperature, and high humidity for a long time. It is highly recommended to store the Module with temperature from 0 to 35 and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD Module in direct sunlight.
- (c) The Module should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light in storing.

## 12.3 Operation

- (a) Do not connect or disconnect the Module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the "Power on/off sequence"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the back light connector and its inverter power supply should be connected directly with a minimized length. A longer cable between the back light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

## 12.4 Operation Condition Guide

- (a) The LCD product should be operated under normal conditions.  
Normal condition is defined as below;
  - Temperature :  $20 \pm 15$
  - Humidity :  $55 \pm 20\%$
  - Display pattern : continually changing pattern (Not stationary)
- (b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc., It is strongly recommended to contact SEC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.

## 12.5 Others

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. ( supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on)  
Otherwise the Module may be damaged.
- (d) If the Module keeps displaying the same pattern for a long period of time, the image may be "sticked" to the screen.  
To avoid image sticking, it is recommended to use a screen saver.
- (e) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.
- (f) Please contact SEC in advance when you display the same pattern for a long time.